

# SEVERE STORM SPOTTING



©David Floyd



David Floyd  
Warning Coordination Meteorologist  
National Weather Service - Goodland KS  
[david.l.floyd@noaa.gov](mailto:david.l.floyd@noaa.gov)



# TOPICS WE'LL DISCUSS

- Introduction
- Why Storm Spotters Are Important
- Spotter Safety
- Thunderstorm Structure
  - Updraft
  - Downdraft
  - Wind Shear
  - Accessory Clouds
- Reporting Severe Weather

## A Typical Year Brings



**6 Hurricanes**



**1270 Tornadoes**



**5000 Floods**



**10,000 Violent  
Thunderstorms**



**Drought  
Conditions**



**500 Deaths  
5000 Injuries  
\$14B in Losses**

# NOAA'S NATIONAL WEATHER SERVICE

- Department of Commerce
- National Oceanic & Atmospheric Administration (NOAA)
- National Weather Service
  - ✓ 15 National Centers
  - ✓ 6 Regional Offices
  - ✓ 122 Field Offices
  - ✓ 13 River Forecast Centers



Goodland Open House – Oct 2006



# NWS FIELD OFFICES

- Collect local data
- Maintain remote sensing equipment
- Issue local forecasts and warnings
- Conduct community outreach
- Provide advice to emergency managers and other government agencies
- Train volunteer observers and storm spotters

## NWS Mission:

Provide climate, water, weather forecasts and warnings to protect life and property and enhance the economy



# HOW IMPORTANT IS THAT?



Parsons manufacturing plant  
before tornado

Storm spotters help us  
achieve our #1 mission

Parsons manufacturing plant  
after tornado

July 13, 2004 ... F4 tornado  
Fatalities = 0  
Injuries = 0

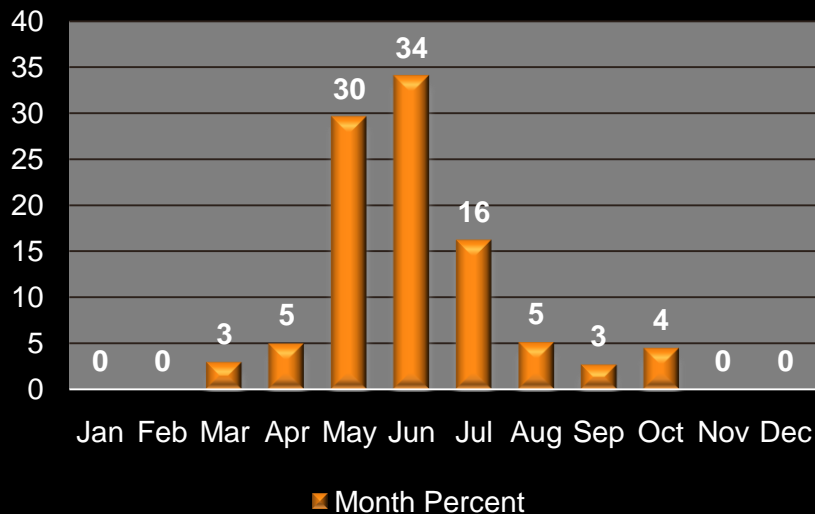
- Advanced warning
- Designated shelters
- Onsite safety officer/storm spotter



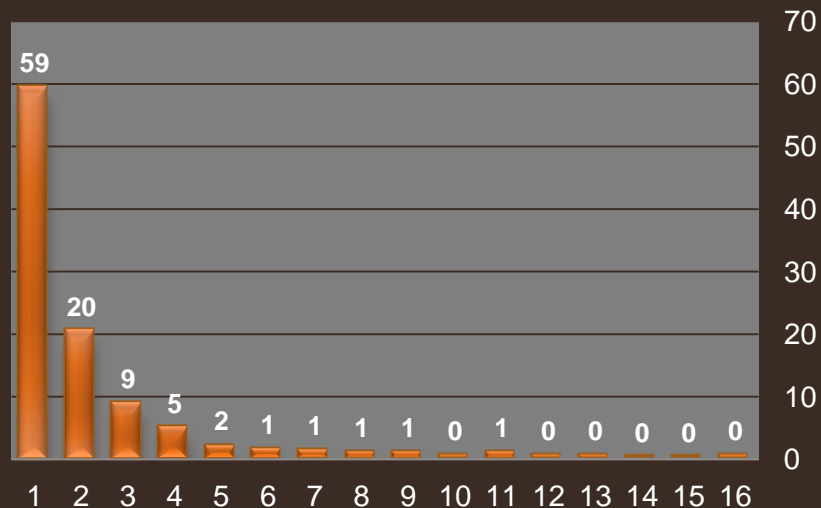
Storm shelters  
circled in yellow



## 1950-2009 Tornadoes



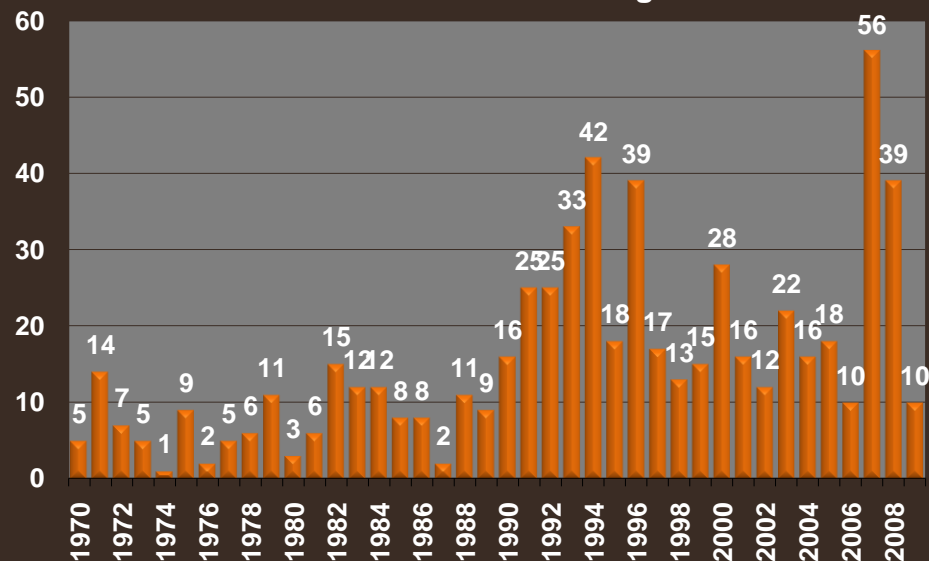
## 1950-2009 Tornadoes / Day Relative Frequency (%)



# TORNADO STATS

## Annual Tornadoes 1970-2009

Goodland 19 County Warning Area  
Total: 621 40 Year Average: 15.5



Each year, there are 45 days when spotters report severe (convective) weather

# SEVERE THUNDERSTORM DEFINITION

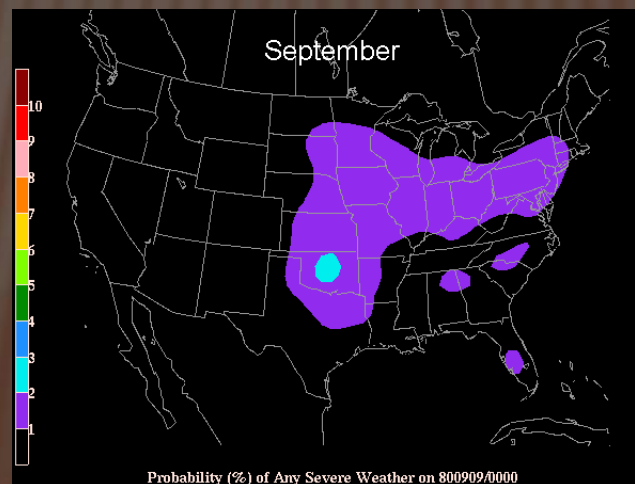
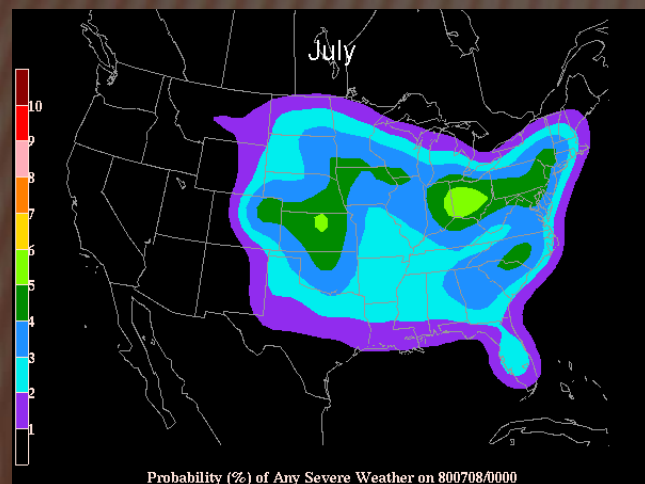
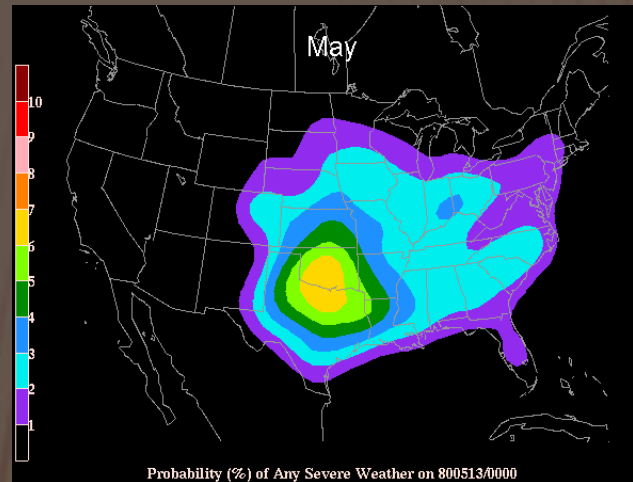
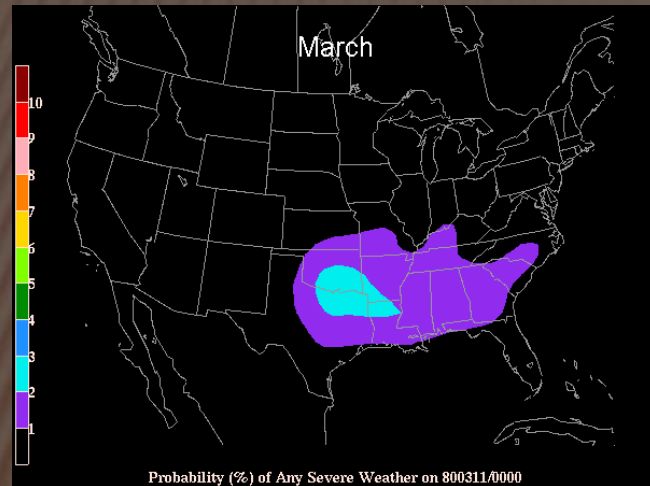
- Hail: Diameter 1" or larger
- Wind: Speed 58 mph or greater
- Wind: Damage
- Tornado: Any



A warning will be issued if either:

- 1) Doppler radar indicates the potential
- 2) A storm spotter confirms an event has occurred

# PROBABILITY OF SEVERE WEATHER



## Goodland CWA

Peak Months

May, June, July

85% of Severe Events

Peak Times

1 - 9 pm

85% of Severe Events

Typical Year

13 Tornadoes

50 Severe Wind

150 Severe Hail



# WHO ARE STORM SPOTTERS?

- Volunteers who serve their community during times of severe weather ... Folks like you and me!
- General public, law enforcement, fire, emergency managers, media, amateur radio operators, storm chasers, CoCoRaHS and cooperative observers

Stay Informed .....**Hazardous Weather Outlook**

Respond to Changes .....**Watch**

Detect the Storms .....**Warning**

Report any Severe Events!

You Save Lives !

# WEB PAGE: WEATHER.GOV/GOODLAND

National Weather Service Weather Forecast Office

## Goodland, KS

Home Site Map News Organization Search for:  NWS All NOAA Go

Local forecast by "City, St" or Zip Code  
 City, St

XML RSS Feeds

Current Hazards  
Watches/Warnings  
Outlooks  
Submit Report

Current Conditions  
Observations  
Radar  
Satellite  
Observed Precip

Forecasts  
Forecast Discussion  
Local Area  
Activity Planner  
Aviation Weather  
Fire Weather  
Severe Weather  
Winter Weather

Hydrology  
Rivers & Lakes

Climate  
Local  
National  
Drought  
More...

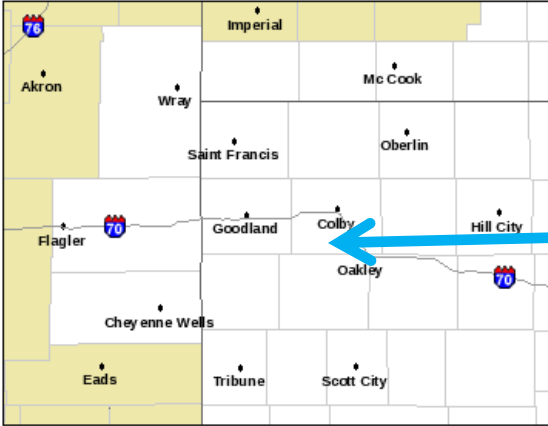
Weather Safety  
Preparedness  
Weather Radio  
StormReady  
SkyWarn

Additional Info  
Items of Interest  
Education Resources  
Coop Observer  
Top News Archives

**Top News of the Day**  
2010 Storm Spotter Schedule

Watches & Warnings Observations Forecast Graphics Rivers & Lakes Climate Fire Weather


Click on the map below for the latest forecast.



Read watches, warnings & advisories  
Zoom Out  
Hazardous Weather Outlook

Last map update: Wed, Feb. 24, 2010 at 4:02:36 pm CST

**Latest Conditions in Goodland, KS** Choose Your Favorite Page City

Feb 24 2:53 pm  **39°F**  
Partly Cloudy (4°C)

Select A City:

Weather Story Radar Satellite Weather Map

Top News of the Day

Most Used Data in tabs

Current Weather Hazards

Point and Click Forecast

Weather Story

Current Radar

# WHAT HAPPENS TO YOUR SPOTTER REPORTS?

- Distributed in real time (within 1-2 minutes) via Local Storm Reports
  - Used by Media, Emergency Managers, Public, Storm Prediction Center

PRELIMINARY LOCAL STORM REPORT...SUMMARY  
NATIONAL WEATHER SERVICE GOODLAND KS  
1225 AM MDT THU MAR 29 2007

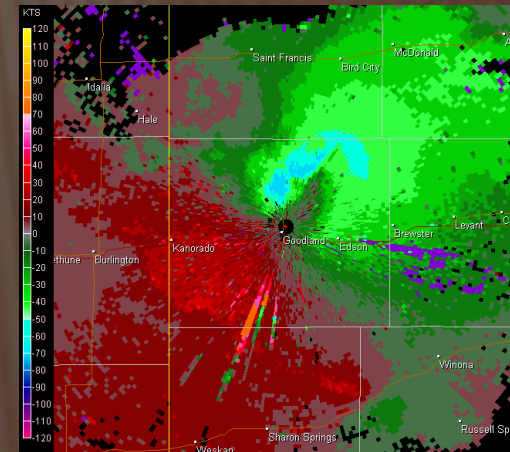
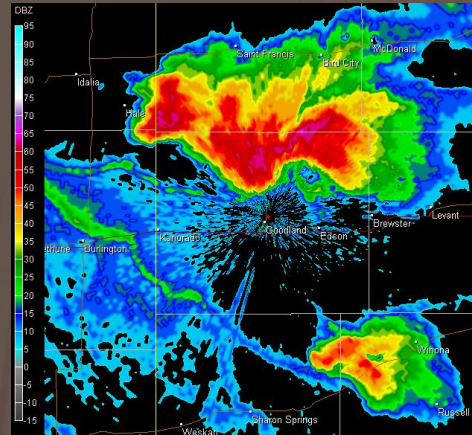
| ..TIME...             | ...EVENT...                              | ...CITY LOCATION...           | ...LAT.LON...                     |
|-----------------------|--|-------------------------------|-----------------------------------|
| ..DATE...             | ....MAG....                              | ..COUNTY LOCATION..ST..       | ...SOURCE....                     |
|                       | ..REMARKS..                              |                               |                                   |
| 0740 PM<br>03/28/2007 | TORNADO                                  | 12 NW TRIBUNE<br>GREELEY KS   | 38.59N 101.91W<br>LAW ENFORCEMENT |
|                       | LAW ENFORCEMENT REPORTS TORNADO CROSSING | COUNTY LINE                   |                                   |
| 0740 PM<br>03/28/2007 | HAIL<br>E1.00 INCH                       | CHEYENNE WELLS<br>CHEYENNE CO | 38.82N 102.35W<br>TRAINED SPOTTER |
| 0752 PM<br>03/28/2007 | TORNADO                                  | 1 E BIRD CITY<br>CHEYENNE KS  | 39.75N 101.51W<br>STORM CHASER    |

DESCRIBED BY MEDIA AS 1/2 MILE WIDE TORNADO WITH POWER  
FLASHES. VIEWED FROM 2 MILES SOUTH OF MCDONALD LOOKING  
WEST TOWARD BIRD CITY



# WHAT HAPPENS TO YOUR SPOTTER REPORTS?

- Correlated with Doppler radar
- Assists in future warning decisions
- Warning Verification



## YOUR REPORT HELPS TRIGGER PUBLIC RESPONSE...

- \* AT 421 PM MDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A SEVERE THUNDERSTORM CAPABLE OF PRODUCING GOLF BALL SIZE HAIL...AND DAMAGING WINDS IN EXCESS OF 60 MPH.
- \* AT 421 PM MDT...TRAINED WEATHER SPOTTERS REPORTED GOLF BALL SIZE HAIL...AND DAMAGING WINDS IN EXCESS OF 60 MPH.

The second phrase would normally get a greater public response because someone has actually observed severe weather.

# RADAR LIMITATION FOR DISTANT STORMS





# DON'T ASSUME!



➤ If you observe a house fire, do you ignore it and assume someone else called 911?



➤ If you observe a traffic accident, do you ignore it and assume someone else called 911?



➤ NWS request: If you observe a severe thunderstorm or storm damage...don't ignore it...don't assume someone else called...report it to NWS

WHEN YOU WITNESS SEVERE WEATHER ...

Who ya gonna call?



©Doug Whitson

# NWS!

What's that number?

**WEATHER SPOTTER**  
**NWS GOODLAND**  
**800-272-7811**

**Provide:**  
Name, Severe Event, Time, Location

**Report:**  
Tornado, Funnel Cloud, Rotating Wall Cloud, 3/4" Hail  
60 mph Wind, Flooding, Deep Ponding, Damage-Injury

0 1/4 1/2 3/4 1 1 1/4 1/2 3/4 2 1 1/4 1/2 3/4 3 1 1/4  
| | | | | | | | | | | | | | |





# GOODLAND OFFICE OPERATIONS FLOOR



# WHAT TO REPORT

- Rain
  - Ponding - flooding
- Hail
  - Penny size or larger
- Wind
  - Wind damage - 60 mph
- Tornado
  - Report all
- Clouds
  - Report wall clouds, funnel clouds





# LET'S TALK ABOUT SPOTTER SAFETY





# TURN AROUND...DON'T DROWN [WWW.FLOODSAFETY.NOAA.GOV](http://WWW.FLOODSAFETY.NOAA.GOV)



- Never walk or drive across flooded roads.
- If your vehicle stalls in high water, abandon it.
- Be especially careful at night... it's hard to judge water depth.



# HAIL



- Large hailstones fall with velocities up to 100 mph!
- Move indoors away from windows, or get inside hard top vehicle.



# TORNADOES

## GET IN...GET DOWN...COVER UP

- Indoors: Seek lowest floor, **interior** room away from windows. Avoid large rooms. Cover your head.
- Outdoors (bad option): Lie face down in a low spot and cover head as a last resort.





# DON'T TAKE SHELTER BENEATH AN OVERPASS



WHY? These areas are collection points for debris. In addition, winds speeds can be up to 25% stronger beneath overpasses

# DOWNBURST WINDS

Storm outflows can reach hurricane force intensity in seconds. Get inside ... flying debris is dangerous.

These images depict damage, not from a tornado, but from thunderstorm outflows.





# LIGHTNING

## WHEN THUNDER ROARS... GO INDOORS

- Can strike 10 miles from main storm tower.
- Get inside building or hard top vehicle at first rumble of thunder.
- Avoid: Open, high places; water; isolated trees; towers; golf courses
- [www.lightningsafety.noaa.gov](http://www.lightningsafety.noaa.gov)
- [www.lightningsafety.com](http://www.lightningsafety.com)





# “THANKS FOR CALLING WITH YOUR REPORT”!



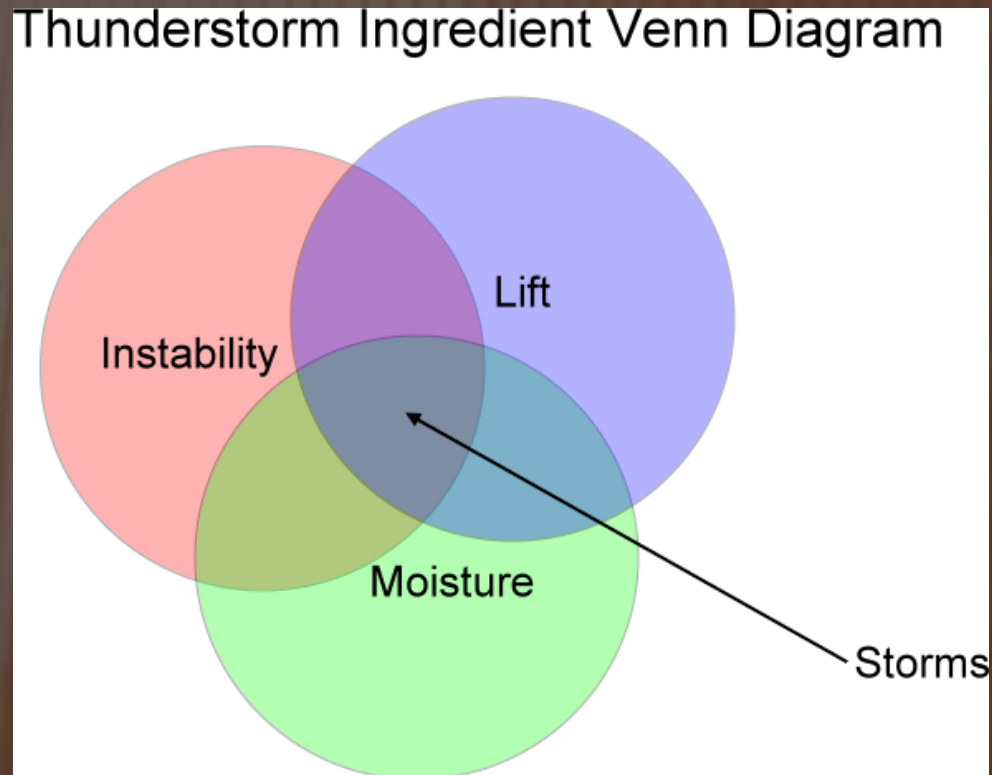
What's that 800 number??

800-272-7811

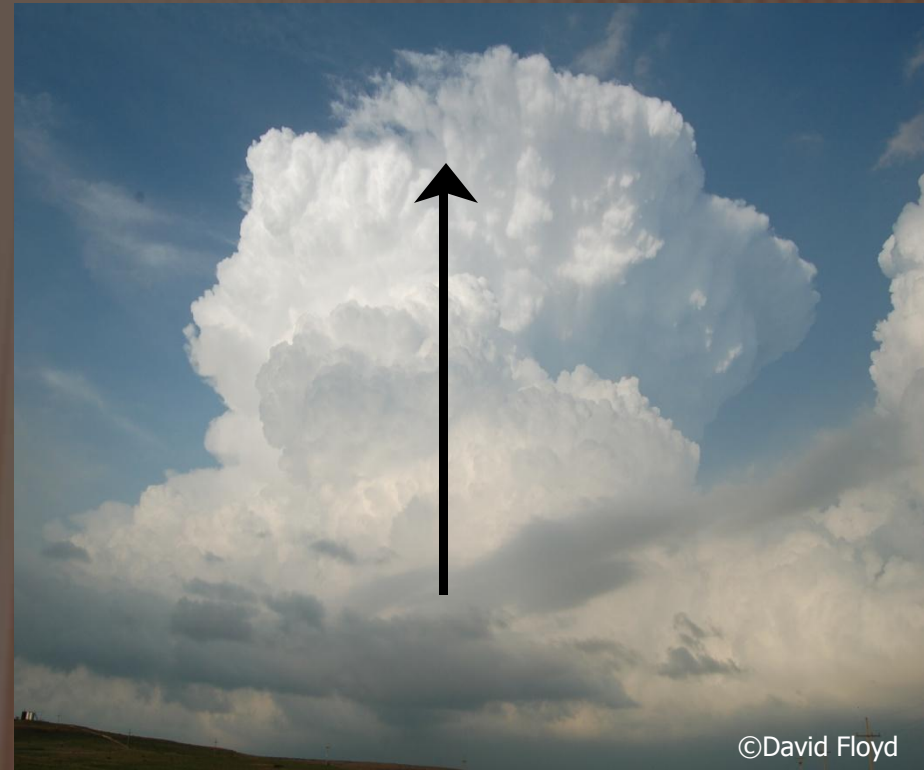
# INGREDIENTS: GENERAL THUNDERSTORMS

- Unstable Atmosphere
- Moisture
- Lifting Mechanism

All three ingredients are needed for thunderstorms. If any one ingredient is missing, storms will not occur.



# BUOYANCY: ONE FACTOR IN UPDRAFT STRENGTH



The greater the temperature excess inside the storm's updraft compared to outside the storm, the more buoyant the cloud will become, and a greater updraft velocity will be realized. Strong storm updrafts are more likely to result in severe weather as compared to weak updrafts.



# WIND SHEAR: ORGANIZES THE STORM

Note the clouds leaning over to the right in this picture. This is the result of wind shear...there are stronger winds near the top of the cloud and lighter winds at the base of the cloud.

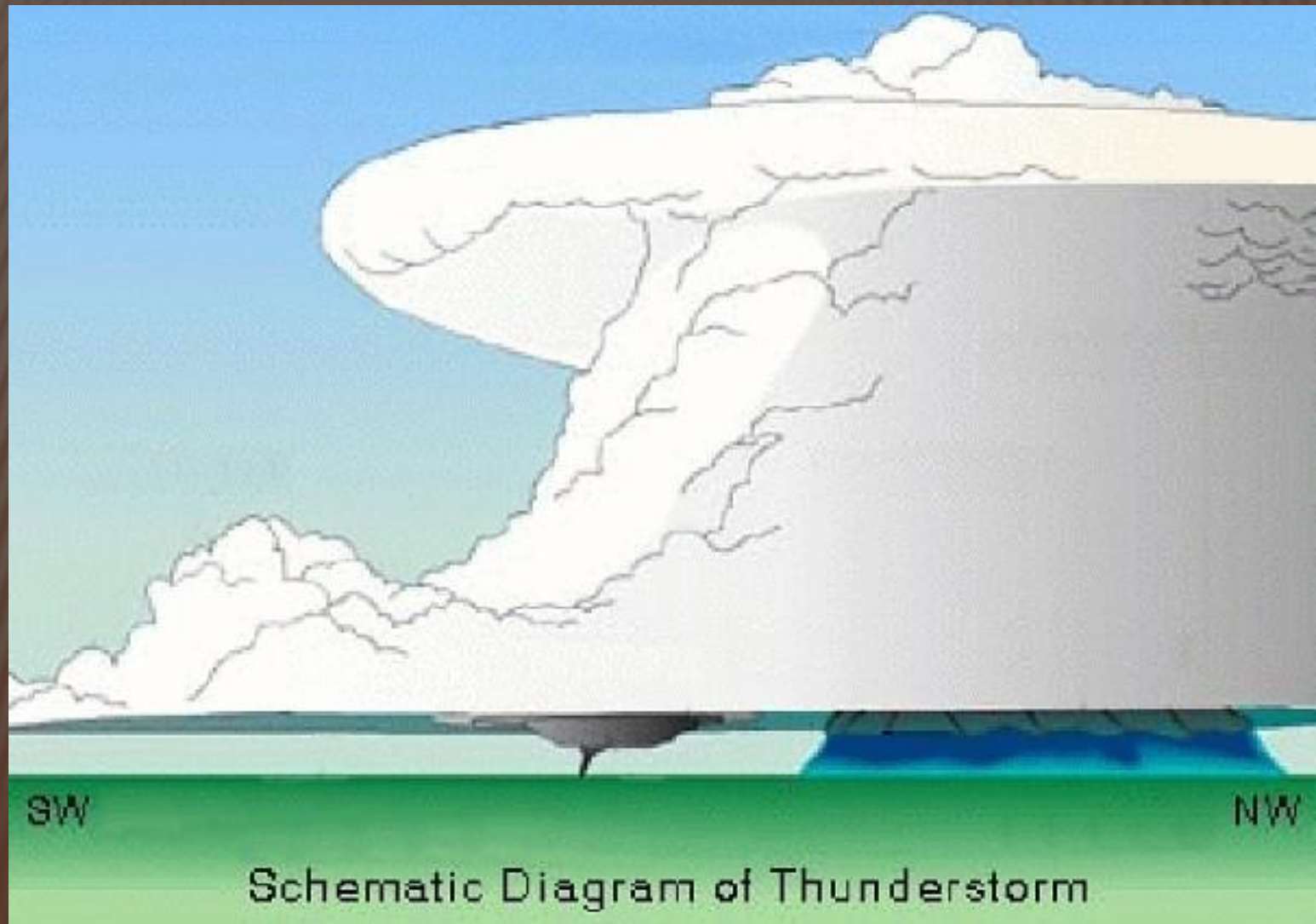
Wind shear is the change of wind direction and/or speed with height. It tends to organize storms by separating the updraft and downdraft so each does not interfere with the other.

If a storm updraft grows in an environment with wind shear, the updraft can be strengthened by the wind shear, resulting in a stronger storm.

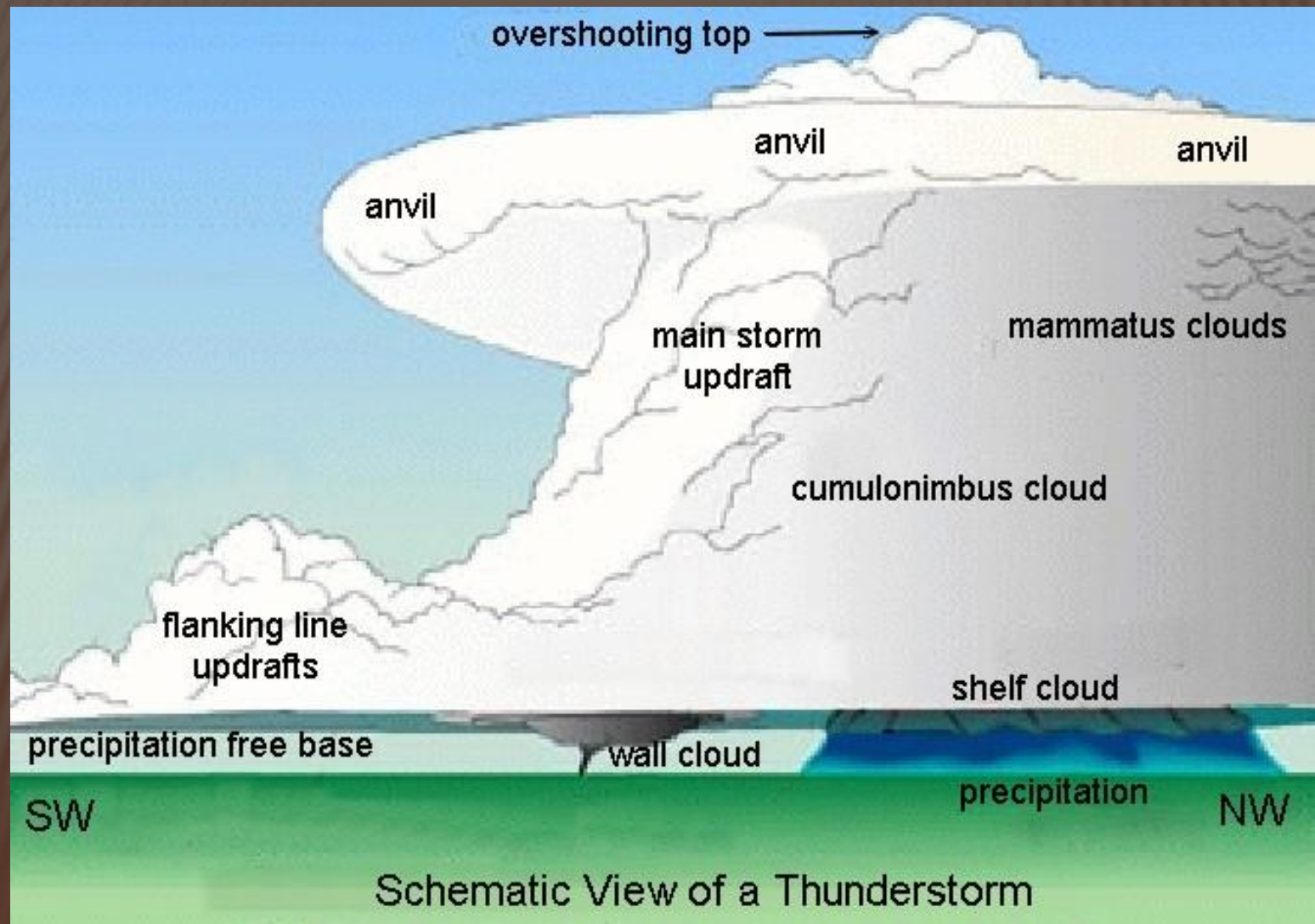


# STORM STRUCTURE –

CAN YOU CORRECTLY IDENTIFY THE PARTS OF THIS THUNDERSTORM?

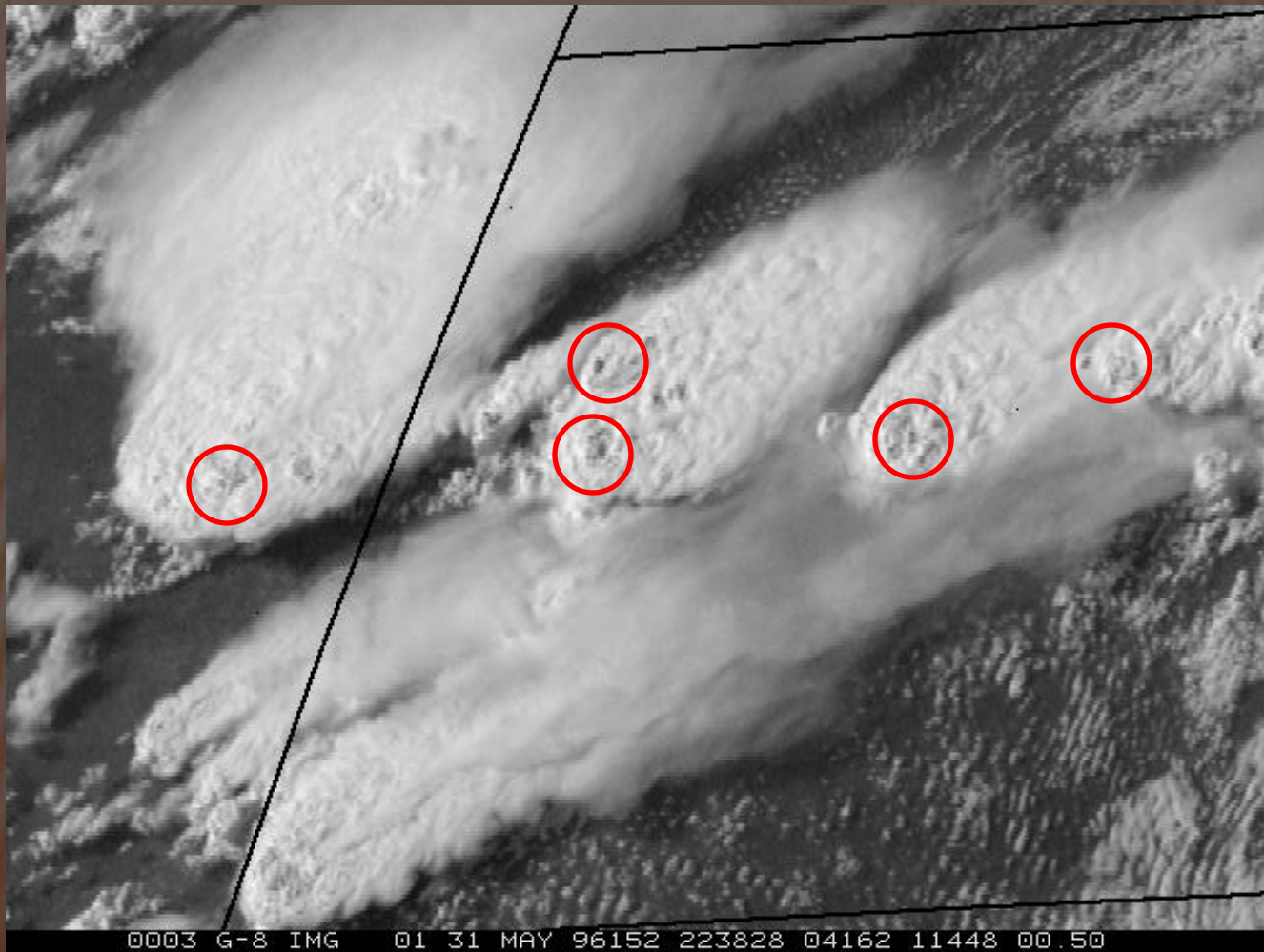


# STORM STRUCTURE





# OVERSHOOTING TOPS FROM SATELLITE



# WATER HOSE – UPDRAFT ANALOGY

The water shooting up out of the hose in the photos below can be compared to a thunderstorm updraft while the resulting spray can be compared to the rain and hail in a storm. Note that on a windy day (right photo), the spray blows downwind from the water shooting up from the hose. A similar effect occurs within thunderstorms, resulting in a more persistent updraft.



# STORM STRUCTURE

In this photo looking north, the storm updraft is on the left while the downdraft is on the right.

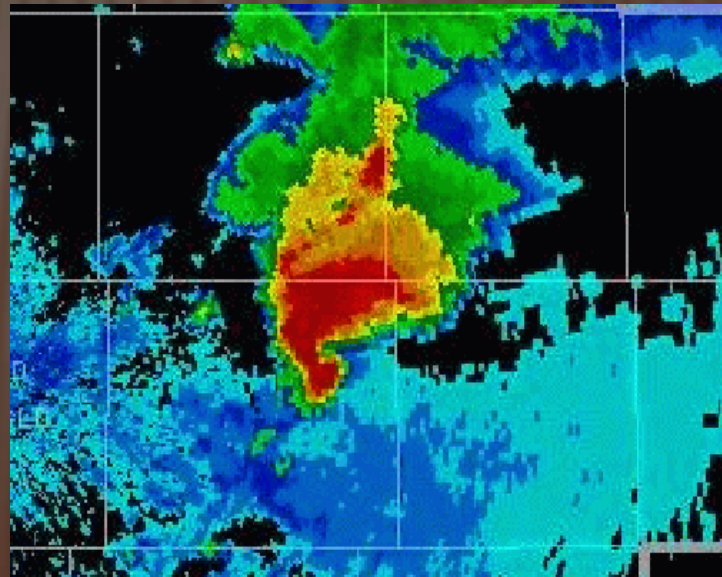
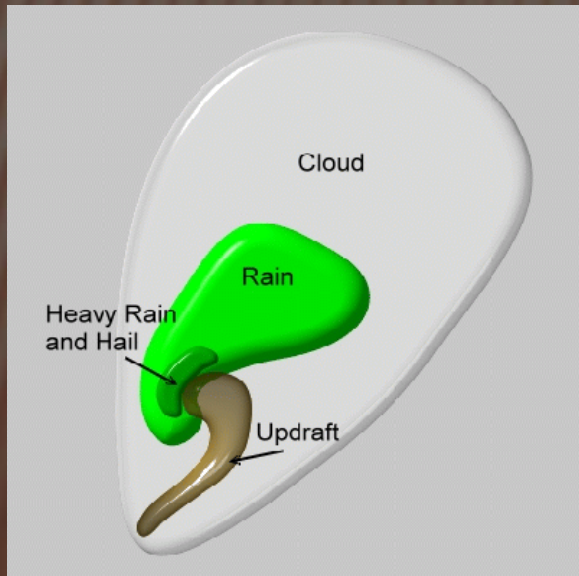
Upper winds are approaching from the left (west) which blows the precipitation downwind to the right.





# PRECIPITATION DISTRIBUTION

Looking down on an organized severe thunderstorm. The diagram on the left shows a typical distribution of rain and hail around a storm. The image on the right is a radar display of a severe thunderstorm. The red colors relate to the heavy rain and hail falling in and around the storm. Spotters must be located (in this case) southeast of the storm to get the best view of the storm's updraft, and important cloud features such as wall clouds, funnel clouds and tornadoes.



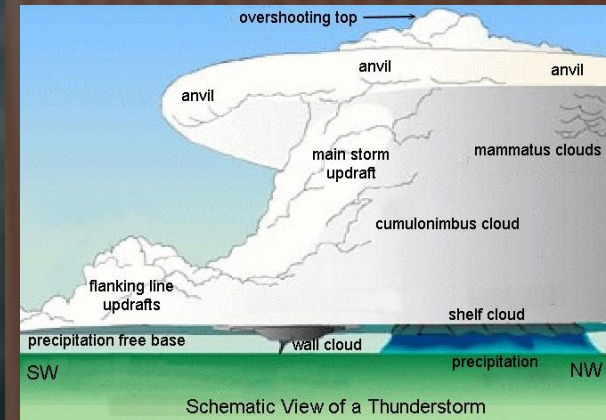
# STORM STRUCTURE

Looking northwest. Updraft is on the left, rain and hail on the right.



# STORM STRUCTURE

Compare this photo of a severe thunderstorm to the schematic view of a typical severe storm on the right. Many similarities exist.





# STORM STRUCTURE

The banded or barbershop pole appearance of this storm's dramatic updraft indicates the storm has a rotating updraft-downdraft couplet. These supercell storms are highly organized, and there is roughly a 90% probability of some type of severe occurring with a supercell storm.



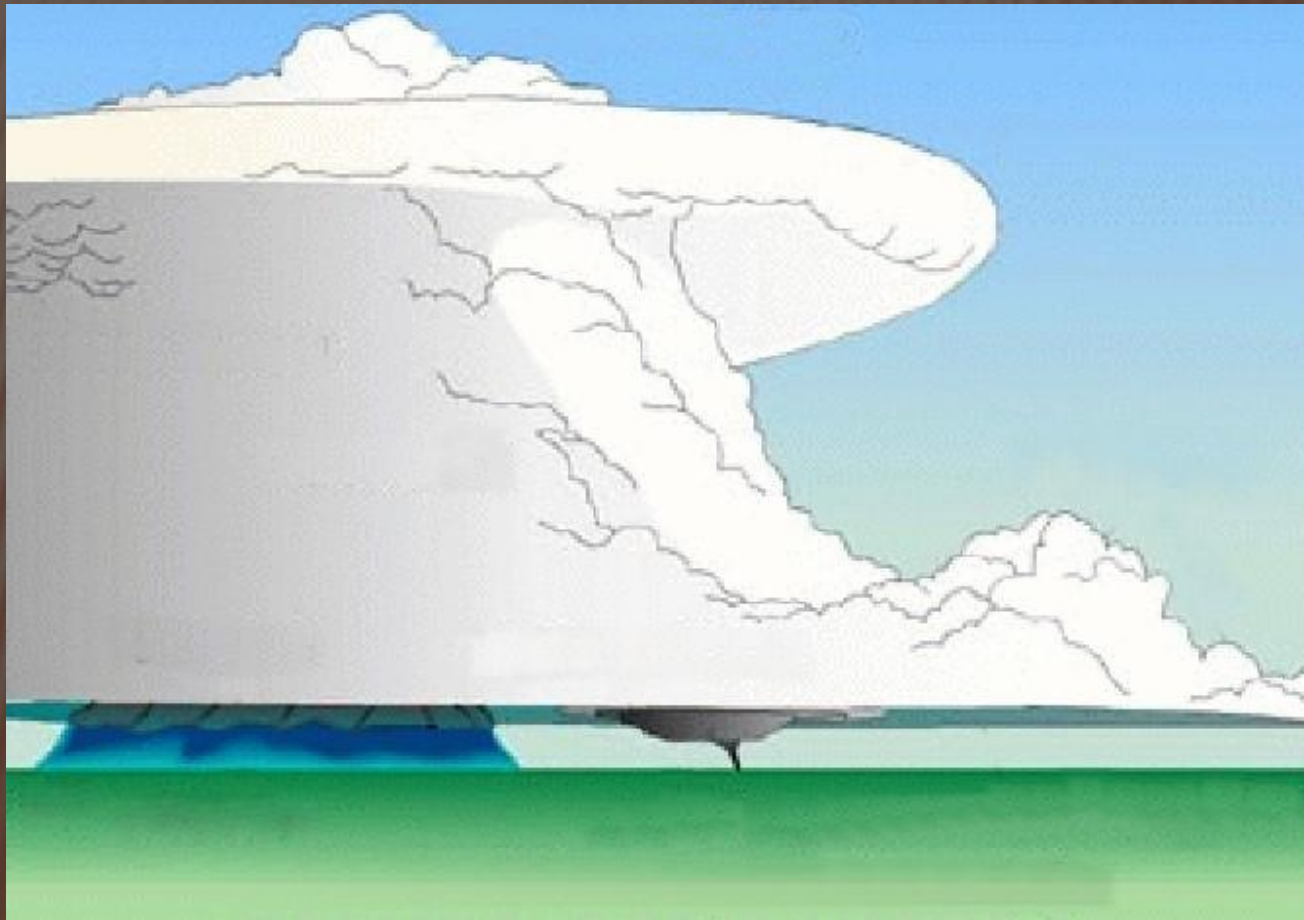
Mike Hollingshead

# STORM STRUCTURE

- At this distance we can only assess general storm features and organization.
- Too far away to observe specific features related to severity.
- This photo is taken looking east, with the updraft on the right side of the storm.
- Spotters must remain flexible and adjust their thinking depending on their location around a storm.



# STORM STRUCTURE – FOR A STORM EAST OF THE SPOTTER





# STORM STRUCTURE



# DOWNDRAFT – OUTFLOW: GRAHAM-NORTON COUNTY, KS

Storms on this day produced 72 mph winds and minor damage in Hill City.



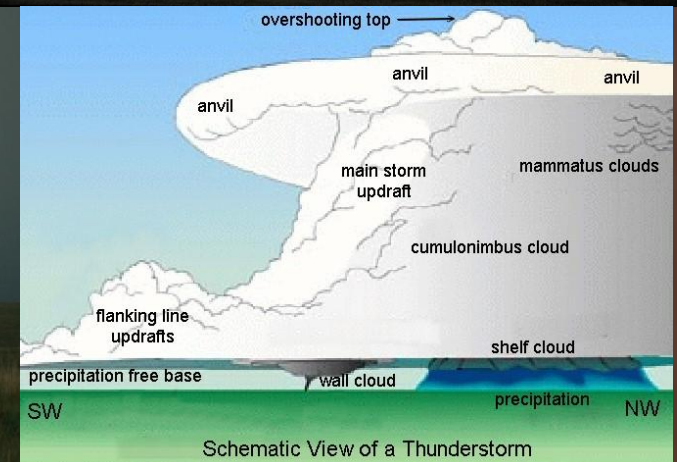
# DOWNDRAFT - OUTFLOW

A rainfoot indicates strong storm outflow. Spotters should be alert for strong straight line winds and possible damage.

**Rainfoot**



© C. Doswell

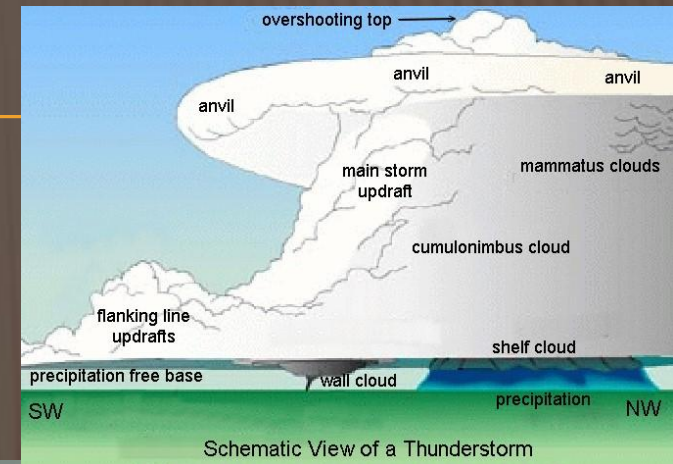


©David Floyd



# DOWNDRAFT - OUTFLOW

Note the blowing dirt and shelf cloud at the leading edge of this storm's outflow.



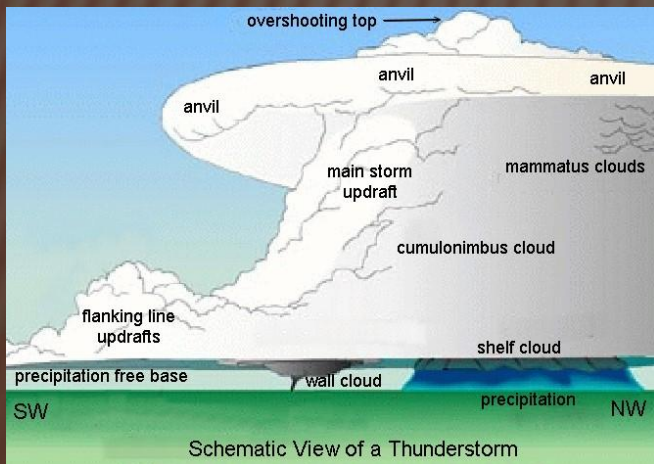
# SHELF CLOUD

Typically at leading edge of storm outflow and downdraft region.

Shelf clouds typically slope down and away from the rain core.



©David Floyd



Schematic View of a Thunderstorm



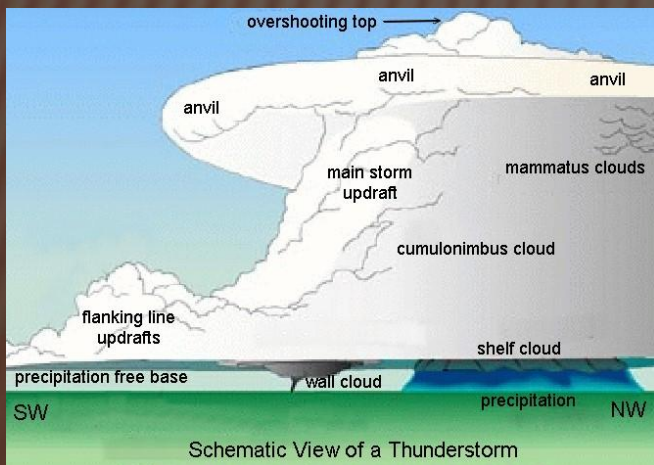
Roll cloud

©David Floyd

# SHELF CLOUD: YUMA COUNTY, CO



- Shelf clouds can be associated either with a single storm, or a line of storms as seen here.



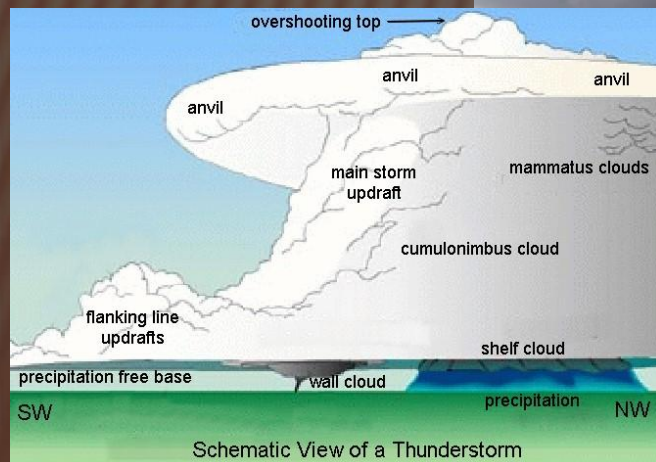


# STORM STRUCTURE AND WALL CLOUD

- Wall clouds are attached to the updraft base and move with the updraft.
- Wall clouds sometimes slope down and toward the rain core.



© Copyright 2005 Eric Nguyen

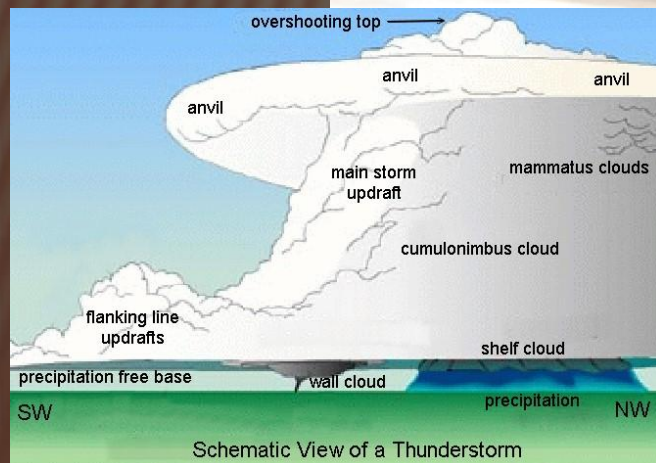


Schematic View of a Thunderstorm

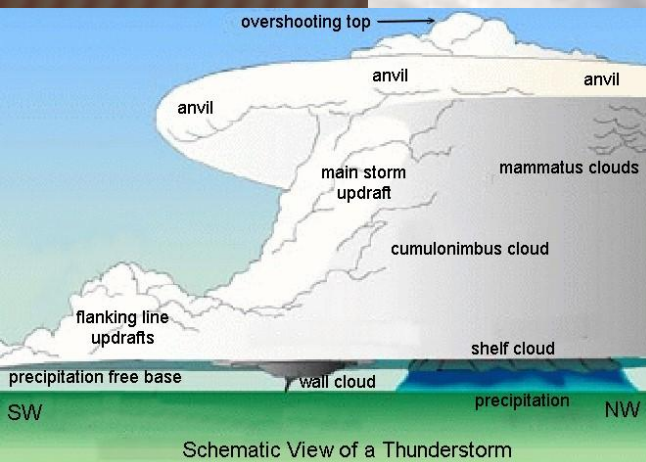
# STORM STRUCTURE AND WALL CLOUD



©www.extremeinstability.com



# STORM STRUCTURE AND WALL CLOUD





# STORM STRUCTURE AND WALL CLOUD



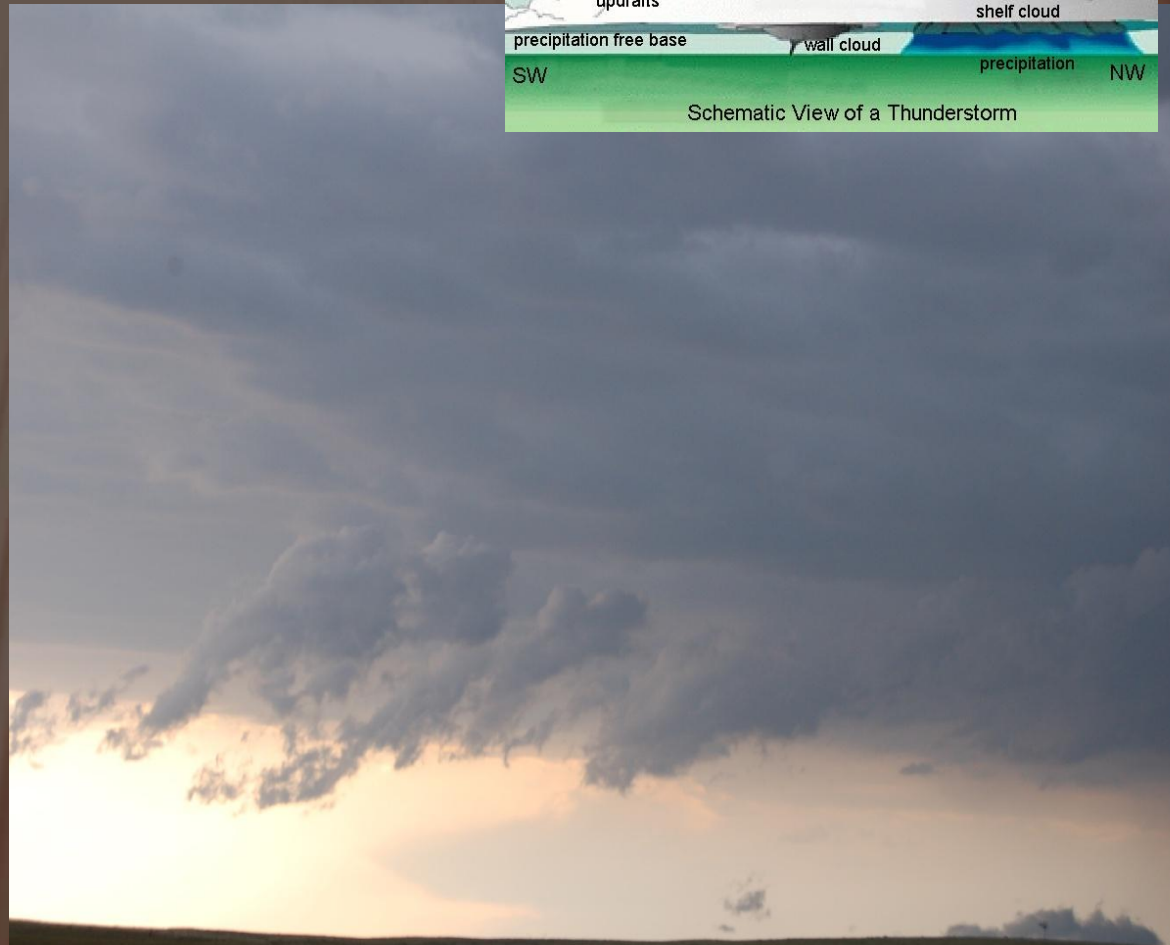
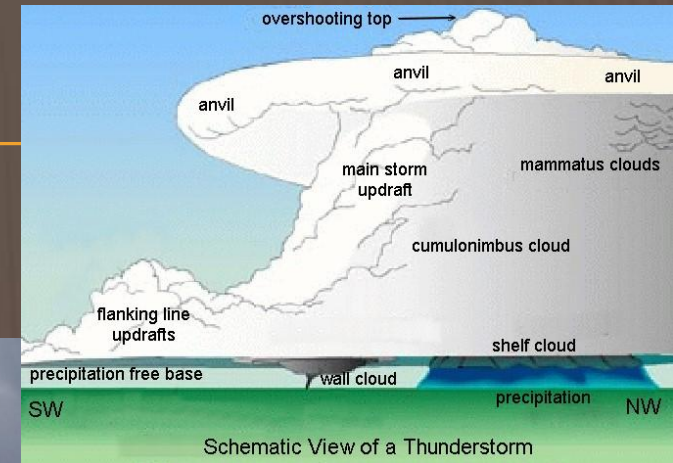
Rotating wall clouds are cause for immediate concern.

If uncertain about rotation, watch the cloud closely for 1-2 minutes.



# SCUD CLOUD

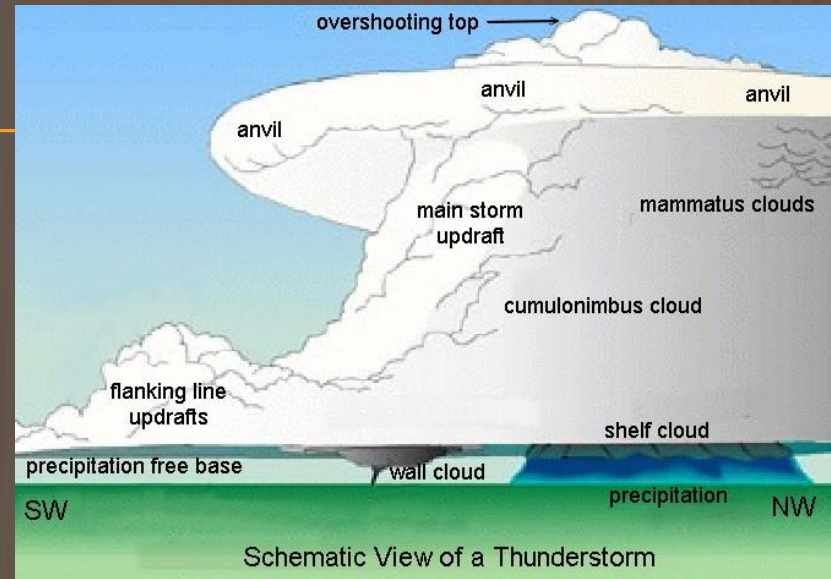
- Scud clouds are often observed moving rapidly away from the rain core
- If caught beneath a strong updraft, they may ultimately reform into a wall cloud.
- Scud clouds are often formed when cool air flows away from the storm's downdraft and interacts with high relative humidity air beneath the storm.
- They are detached from the cloud base.



# SCUD CLOUD

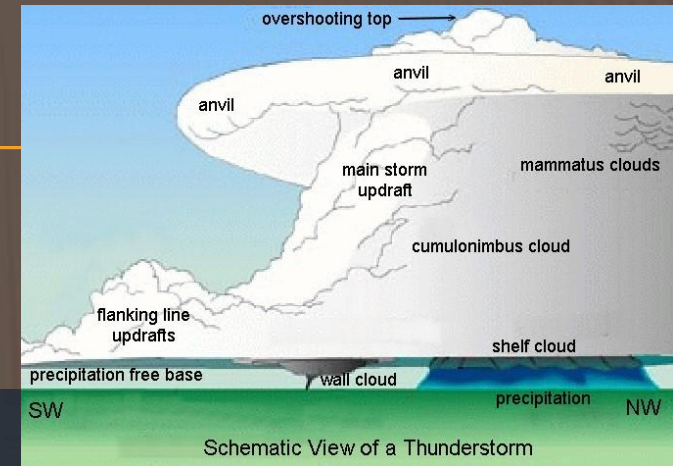


Scud clouds are often mistaken for funnel clouds and tornadoes. True funnel clouds are only seen beneath a storm updraft.





# SCUD CLOUD: NORTON, KS



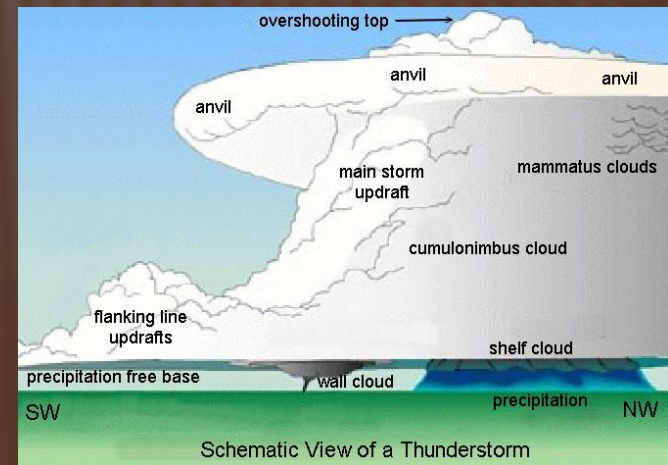
Scud cloud  
formation and  
dissipation

# FUNNEL CLOUD

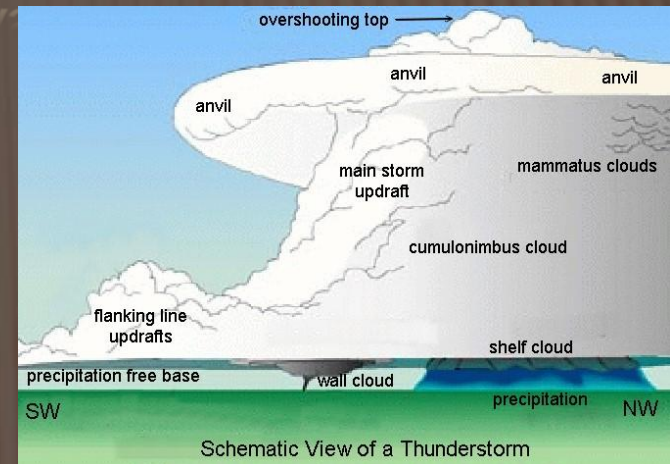
Funnel clouds are typically smooth in appearance and are located under a storm or cloud updraft



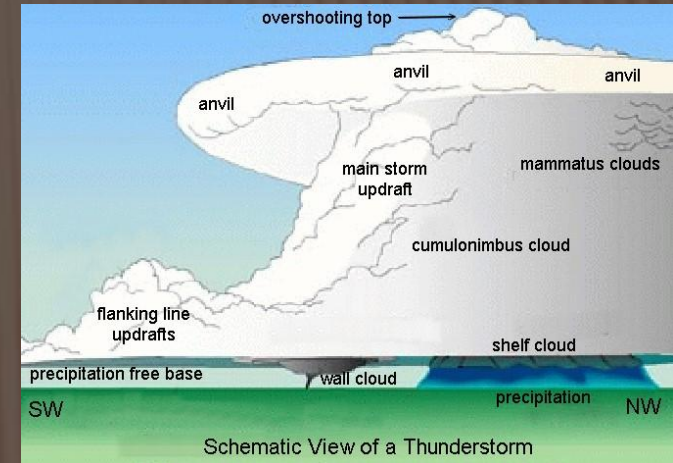
©Al Pietrycha



# FUNNEL CLOUD: WALLACE COUNTY, KS







Compare the smooth appearance of the funnel clouds in the last two slides with the ragged and torn appearance of these scud clouds.



# HOW TO REPORT SEVERE WEATHER

To Report Severe Weather...

Call: **1-800-272-7811**

Tell us...

WHO you are.

WHAT event occurred.

WHEN the event occurred ... HOW LONG it lasted.

WHERE you are located ... WHERE the event occurred.

Remain CALM and SAFE during spotting activity.

# ITEMS TO REPORT

- Rain
  - Ponding - flooding
- Hail
  - Penny size or larger
- Wind
  - Wind damage - 60 mph
- Tornado
  - Report all
- Clouds
  - Report wall clouds, funnel clouds

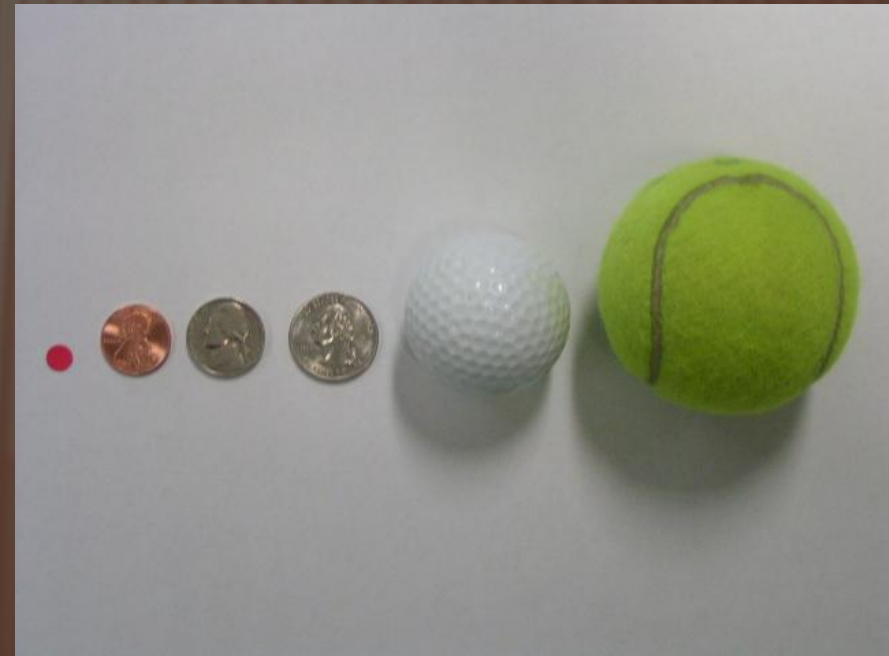




# ESTIMATING HAIL SIZE



Don't reference marbles when reporting hail size. Use a coin reference to minimize confusion.



**WEATHER SPOTTER**  
**NWS GOODLAND**  
**800-272-7811**



**Provide:**

Name, Severe Event, Time, Location

**Report:**

Tornado, Funnel Cloud, Rotating Wall Cloud, 3/4" Hail  
60 mph Wind, Flooding, Deep Ponding, Damage-Injury

0 1/4 1/2 3/4 1 1 1/4 1/2 3/4 2 1 1/4 1/2 3/4 3 1 1/4

# ESTIMATING WIND SPEED : BEAUFORT SCALE

| Wind Speed Estimation | Description   |
|-----------------------|---|
|                       |   |
| less than 1 mph       | Calm; smoke rises vertically  |
| 1 - 3 mph             | Direction of wind shown by smoke drift, but not by wind vanes             |
| 4 - 7 mph             | Wind felt on face; leaves rustle; ordinary vane moved by wind             |
| 8 - 12 mph            | Leaves and small twigs in constant motion; wind extends light flag        |
| 13 - 18 mph           | Raises dust and loose paper; small branches are moved                     |
| 19 -24 mph            | Small trees in leaf begin to sway; crested wavelets form on inland waters |
| 25 - 31 mph           | Large branches in motion; whistling heard in telephone wires              |
| 32 - 38 mph           | Whole trees in motion; inconvenience felt walking against the wind        |
| 39 - 46 mph           | Breaks twigs off trees; wind generally impedes progress                   |
| 47 - 54 mph           | Slight structural damage occurs   |
| 55 - 63 mph           | Damage to chimneys and TV antennas; pushes over shallow rooted trees      |
| 67 - 74 mph           | Rarely experienced; structural damage becomes possible                    |
| above 75 mph          | Very rarely experience; see Fujita scale descriptions                     |

# ACTION AREAS

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- Tornadoes / Funnel Clouds  
Associated with updraft, often rapidly growing towers above.  
Mechanism is stretching, or tilting and stretching.
- Wall Clouds  
Associated with updraft, often rapidly growing towers above.
- Hail  
Associated with downdraft, often falls with the rain.
- Strong Wind  
Associated with downdraft and outflow, with or without rain.
- Flash Floods  
Associated with intense, and/or prolonged rainfall. May be miles from a storm, and later in time.



# QUESTIONS?

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David Floyd  
Warning Coordination Meteorologist  
National Weather Service  
920 Armory Road  
Goodland, KS 67735

Web: [weather.gov/goodland](http://weather.gov/goodland)  
Email: [david.l.floyd@noaa.gov](mailto:david.l.floyd@noaa.gov)  
Call: N5DBZ